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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of any patent issued thereon.

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Device for electrical connection of a connecting line to an electrode, in particular a medical engineering skin electrode

The invention relates to a device for electrical connection of a connecting line to an electrode, in particular a medical engineering skin electrode.

Devices for electrical connection of a connecting line to an electrode, in particular a medical engineering skin electrode as specified in the preamble of claim 1, have been disclosed in DE 37 19 474 A1. Connecting devices such as this are used, for example, for measurement of physiological signals from living beings, such as heart action voltages (electrocardiogram, EKG). For this purpose electrodes are positioned on the skin, by means of an adhesive, for example, and are connected to an electric connecting line over which the physiological signals in electric form are conducted to an evaluating device. The device as disclosed operates as a snap fastener

connection and is snapped onto the contact pin of the electrode. The contact pin may be a separate element of the electrode of conventional design or may, for example, form the electrode surface itself in conjunction with a lower side of a plate-shaped base component.

The user makes heavy demands of such devices. Thus, it should be possible to make and break the connection without application of great force, while at the same time a durable electric connection of high quality is to be produced. An obstacle to meeting these requirements is presented by the fact that the electrodes used are generally mass-produced, being made for one-time use. For this reason the connecting heads of the electrodes present only low dimensional accuracy and high tolerances. In addition, the dimensions vary from manufacturer to manufacturer.

Consequently, so-called electrode clamps have been developed as an alternative to the generic devices disclosed. Operating legs are opened against the force of a spring and are mounted on the head of the electrode, electrical contact being established when the electrode clamps are released. It is true that the retaining force can be set very effectively by means of the spring used, and as a rule no problem is encountered in release of the electrode clamps. However, electrode clamps such as this present the disadvantage that, because of the structural configuration of the operating legs, the contact member has an external shape with multiple surfaces and accordingly is not suitable for wearing under clothing.

Hence it is the object of the invention to provide a generic device which eliminates the disadvantages of the state of the art. In particular, a device is to be provided which may be connected to the electrode and disconnected from the electrode with low application of force but nevertheless has high retaining strength. By preference the device is also to be suitable for wearing under clothing. In addition, the conventional insulation requirements set for medical engineering applications are to be satisfied.

The problem is solved by the device specified in claim 1. Specific embodiments are defined in the dependent claims.

The problem is solved in the case of a device for electrical connection of a connecting line to an electrode, a medical engineering electrode in particular, with a contact member for plug connection to a contact pin of the electrode, the contact member having an energy storing element for establishment of spring-loaded application of contact of a contact zone of the contact member to the contact pin of the electrode, in that the device has at least one actuating element mounted so as to be displaceable, by means of which element the energy storing element may be deflected when it is displaced and the contact zone of the contact member thereby operated so as to effect opening.

The contact member preferably is designed to be more or less two-dimensional and the opening movement of the contact member preferably is accomplished by deflection or displacement of the contact member more or less parallel to the surface formed by the contact member. In particular, deflection of the energy storing element and accordingly storage of energy take place when the actuating element is displaced. As a result of the opening actuation of the contact zone of the contact member the contact pin may be introduced into the device with almost no expenditure of energy and during the subsequent resetting of the actuating element the contact zone is brought by means of the stored energy into electrically conductive contact on the contact pin of the electrode. A long lasting contact of the contact member ensuring reliable contact which subjects the contact zones to less mechanical stress is thereby obtained. High opening forces may be applied without a problem as a result of the pushing operation of the actuating element. As a result, high retaining forces and thus high contact forces may also be provided and the device may nevertheless be easily applied to the electrode and separated from it.

The contact member preferably has two contact zones for the contact pin which are positioned symmetrically in relation to the axis of introduction of the device, these contact zones being designed to be more or less folded by bending of a contact tongue or to be two-dimensional. The legs of the spring forming the energy storing element and being, for example, in the form of strips preferably are bent at an angle to the surface of the contact tongues, in particular at a right angle. The entire contact member preferably is designed to be integral as a stamped/bent component.

The translatory movement of the actuating element preferably is reoriented by the device claimed for the invention to rotary movement of the drive element. For this purpose the actuating element is eccentrically coupled to the drive element mounted rotatably in the housing of the device. The drive element and that actuating element preferably are coupled eccentrically to each other by way of a pin introduced into a slot.

Also by way of preference the rotary movement of the drive element is converted to translatory movement by which the contact member is actuated to effect opening. For this purpose the drive element may have, for example, a contact surface extending eccentrically by means of which the contact member is actuated. The eccentrically extending contact surface preferably is in contact with the contact member, in particular with the energy storing element of the contact element. For example, the drive element may have a journal in one piece or several pieces projecting from the base plate, the surface of the journal, a rounded surface, for example, being flattened or blocked in at least one place. By means of the flattening or blocking the journal may come in contact with the contact element during rotation and deflect it as required.

In order to prevent straining of the energy storage of the contact element, the movement of the actuating element is limited. For this purpose the drive element and the actuating element preferably have interacting stopping means which limit displacement of the actuating element.

Optionally or in addition the actuating element and the housing of the device also may have stopping means.

In one particular embodiment of the invention two actuating elements are mounted on opposite sides of the device. Consequently, application of high forces may be combined with simplicity of handling, for example, through actuation of the two actuating elements by thumb and index finger of one hand. The two actuating elements preferably are coupled with a common drive element.

In one particular embodiment the device has a rounded shape as seen in a top view. For example, the outline may, in particular when the device is connected to the electrode, be more or less circular in shape with the radially outgoing connecting line as seen in a top view. The outline may also be rounded as seen in a side view; in particular the device may have a cylindrical basic shape, with a rounded edge between cover surface and jacket.

In one particular embodiment of the invention the housing has, on the surface facing the electrode with which contact is to be established, an elastoplastic wall the hardness of which is lower than that of another wall of the housing, preferably lower than that of the other housing shell. The deformable wall preferably is made of a thermoplastic elastomer, and, as a result of the soft elastic deformability, guarantees snug fitting of the device on the electrode with which contact is to be made. Consequently, the contact reliability is increased and the comfort of wearing such devices is improved as well.

Other advantages, features, and details of the invention are specified in the dependent claims and in the following description, in which an exemplary embodiment is described in detail with reference to the drawings. Each of the features mentioned in the claims and in the description may be essential to the invention singly or in any combination of features.

FIG. 1 shows the individual components of a device claimed for the invention in an exploded view,

FIG. 2 the configuration of the device in FIG. 1 as viewed from the bottom,

FIG. 3 connection of the contact member to the connecting line,

FIG. 4 introduction of the contact member into the body of the housing,

FIG. 5 the flexible wall on the bottom,

FIG. 6 the last steps of assembly, and

FIG. 7 the device claimed for the invention assembled and ready for operation.

FIG. 1 shows the individual elements of a device 1 in an exploded view. The device 1 for electric connection of a connecting line 2 to an electrode 44 has a contact member 3 for plug connection to a contact pin 43 of the electrode 44. The structure of the contact member 3 is more or less that disclosed in DE 37 19 474 A1. In particular, the contact member has two energy storing elements 4 in the form of spring legs extending parallel to each other when not extended, the spring legs forming a one-piece contact bead 5 in their central area. With their ends, which are spaced a certain distance from the energy storing element 4, the contact beads 5 form a contact zone which in a side view is seen to be curved or wedge-shaped and in a top view straight, wedge-shaped, or curved and which extends into an opening for the contact pin 43 of the electrode 44 with which contact is to be established. The energy storing elements 4 are fastened on the more or less flat contact member 3 near their end on the longitudinal side.

The housing body 6, more or less circular as seen in the top view and preferably more or less cylindrical, has, diametrically opposite its longitudinal axis 10, openings 11, 12 into each of which an actuating element 8, 9 may be introduced. Both actuating elements 8, 9 are identical in shape as equal parts, for which reason only one actuating element 8 is to be described in detail in what follows.

As seen in the top view the actuating element 8 is U-shaped, with two legs 13, 14 of different lengths. The connecting section 15 connecting the legs 13, 14 replicates the outline of the housing body 6 as seen in the top view and has a raised edge 25. The longer leg 14 has on its end opposite the connecting section 15 a slot 16 into which is introduced a pin 19 preferably integral with the drive element 18. When the actuating element 8 is actuated in the direction of the arrow 20, the drive element 18 is set in rotation in the direction of the arrow 21 as a result of the eccentric mounting of the pin 19 relative to the axis of rotation of the drive element 18, which axis coincides with the longitudinal axis 10 of the housing body 6. In addition, a corresponding situation arises in the case of movement of the other actuating element 9 in the direction of the arrow 22. Both actuating elements 8, 9 preferably are actuated at the same time.

Actuation takes place against the action of the helical spring 23, one end of which is seated in a boring 24 in the connecting section 15 and the other of which rests against the housing body 6. The actuating element 8 forms on the longer leg 14 a first stopping means 26 in the form of a catch which, when the actuating element is introduced into the housing body 6, comes into contact with a second stopping means 27 in the form of the drive element 18 and thereby prevents further introduction of the actuating element 8 into the housing body 6.

The drive element 18 also comprises a drive journal 28 the longitudinal axis of rotation 10 of which is oriented toward the opening 7 of the contact member 3. In the exemplary embodiment illustrated the drive element 18 is configured in two pieces, the drive journal 28 in

particular being connected by positive locking by insertion into the drive cover 29 and being non-rotatably connected to the latter. While the drive cover 29 consists of a plastic, the drive journal 28 is of metal. Similarly, the drive cover 29 and the drive journal 28 may be configured to be of one piece, in particular one of plastic, but if necessary also of metal.

On its end opposite the drive cover 29 the drive journal 28 has a cylindrical jacket surface 30 having flattened areas 31 on two opposite sides. In the initial situation illustrated the width of the drive journal 28 between the two flattened areas 31 corresponds more or less to the spacing of the two energy storing elements 4 of the contact member 3. When the drive element 18 is rotated in the direction indicated by the arrow 21, however, the jacket surface 30, which, for example, is partly cylindrical, comes to rest against the energy storing elements 4 and moves the latter apart so that the contact beads 5 clear the opening 7 for entry of the contact pin 43.

FIG. 2 illustrates the configuration of the device 1 of FIG. 1 as seen from the lower side. On its frontal surface facing the contact member the drive journal 28 has an insertion opening 32 for the contact pin 43. The width of the insertion opening 32 corresponds more or less to that of the opening 7 in the contact member 3. The housing body 6 has on its lower side shown in FIG. 2 a positive-locking recess 33 for the contact member 3. Consequently, the contact member is fastened exclusively by positive-locking insertion into the housing body 6. In addition, the housing body 6 forms an integral support 34, radially projecting and partly circular in cross-section, for the connecting line 2.

The device claimed for the invention preferably is produced in the following steps.

First the connecting line 2 is electrically connected to the contact member 3, preferably by means of a crimped connection 46. In addition, a strain relief sleeve 45 is mounted on the connecting line 2. The situation thus reached is shown in FIG. 3.

The connecting line 2 with the contact member 3 is introduced from the lower side into the recess 33 in the housing body 6 and fastened in the recess 33. This situation is illustrated in FIG. 4.

The housing body 6, with the contact member 3 inserted, is then introduced into the injection mold of a plastic molding machine for the purpose of molding or injecting an elastoplastic wall 47 on or in the surface of the device 1 associated with the electrode 24 with which contact is to be made. In order to provide additional protection from mechanical stress, the flexible socket 48 is simultaneously or subsequently molded onto the connecting line 2 or the housing body 6. The wall 47 preferably is made of a thermoplastic elastomer of sufficiently low hardness in order to ensure snug fitting to the shape of the electrode 44. The situation thereby reached is illustrated in FIG. 5.

The two actuating elements 8, 9 are then introduced into the housing body 6 and the drive element 18 is inserted from above. Rotation of the drive element 18 may be effected either by flanged guide surfaces 49 formed by the housing body 6 and in particular by the recess 33, which surfaces function in conjunction with the corresponding circumferential surfaces of the drive journal 28, or by the circular guide opening 50 provided on the upper side of the housing body 6, which opening functions in conjunction with the circumferential shape of the drive cover 29.

When the drive element 18 is introduced, the pins 19 of the drive cover 29 are engaged in the slot 16 of the two actuating elements 8, 9, as a result of which the latter are mounted in the housing body 6 so as to be movable or captive. FIG. 6 illustrates the last steps of assembly, while FIG. 7 shows the device 1 claimed for the invention completely assembled and ready for operation.

Claims

1. A device (1) for electric connection of a connecting line (2) to an electrode (44), in particular a medical engineering skin electrode, with a contact member (3) for plug connection to a contact pin (43) of the electrode (44), the contact member (3) having an energy storing element (4) for establishment of contact by the force of a spring of the contact member (3) with the contact pin (43) of the electrode (44), **characterized in that** the device (1) has at least one actuating element (8, 9) mounted so that it may be deflected and the energy storing element (8, 9) and accordingly the contact member (3) may be actuated so as to effect opening.

2. The device (1) as claimed in claim 1, wherein the actuating element (8, 9) is connected eccentrically on a rotatably mounted drive element (18).

3. The device (1) as claimed in claim 2, wherein the drive element (18), with a contact surface (31) extending eccentrically, when rotated actuates the contact member (3) so as to effect opening.

4. The device (1) as claimed in claim 2 or 3, wherein the drive element (18) and the actuating element (8, 9) are connected to each other eccentrically by way of pin (19) engaged in a slot (16).

5. The device (1) as claimed in one of claims 2 to 4, wherein the drive element (18) and the actuating element (8, 9) have interacting means (26, 27) which limit the displacement of the actuating element (8, 9).

6. The device (1) as claimed in one of claims 1 to 5, wherein two actuating elements (8, 9) are mounted on opposite sides of the device (1).

7. The device (1) as claimed in claim 6, wherein the two actuating elements (8, 9) are connected eccentrically on a common, rotatably mounted drive element (18).

8. The device (1) as claimed in one of claims 1 to 7, wherein the device (1) has a rounded shape when seen in a top view.

9. The device (1) as claimed in one of claims 1 to 8, wherein the housing of the device has, on the surface facing the electrode (44) with which contact is to be established, an elastoplastic wall (47) the hardness of which is lower than that of the other wall of the housing.

10. The device (1) as claimed in claim 9, wherein the elastoplastic wall (47) is made from a thermoplastic elastomer.

Abstract

1. A device for electrical connection of a connecting line to an electrode, in particular a medical engineering skin electrode.

2. The invention relates to a device (1) for electric connection of a connecting line (2) to an electrode (44), in particular a medical engineering skin electrode, with a contact member (3) for plug connection to a contact pin (43) of the electrode (44), the contact member (3) having an energy storing element (4) for establishment of contact established by the force of a spring of the contact member (3) with the contact pin (43) of the electrode (44), **characterized in that** the device (1) has at least one actuating element (8, 9) mounted so that it may be deflected and the energy storing element (8, 9) and accordingly the contact member (3) may be actuated so as to effect opening.

3. FIG. 1.

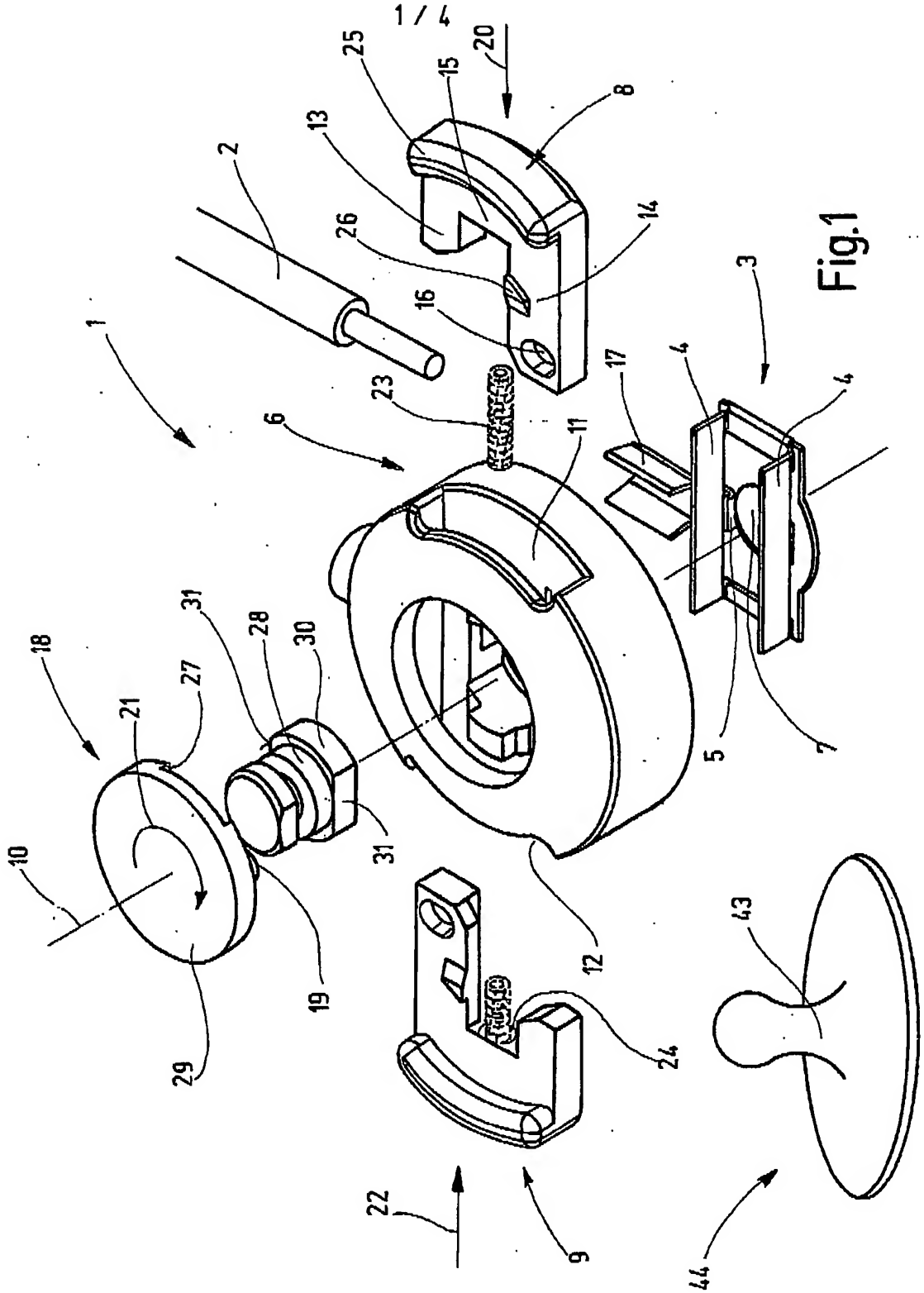
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Fig.1

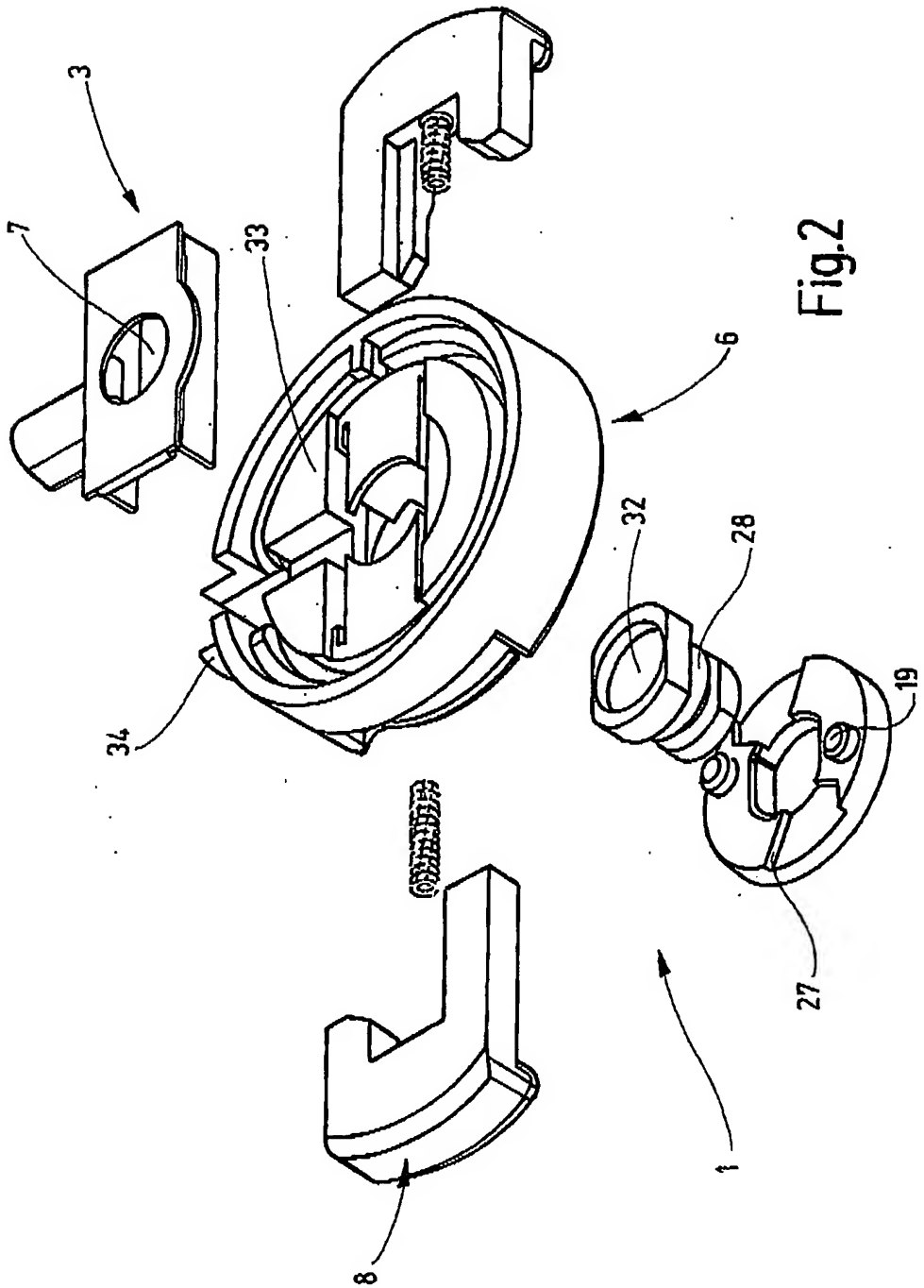

Fig.2

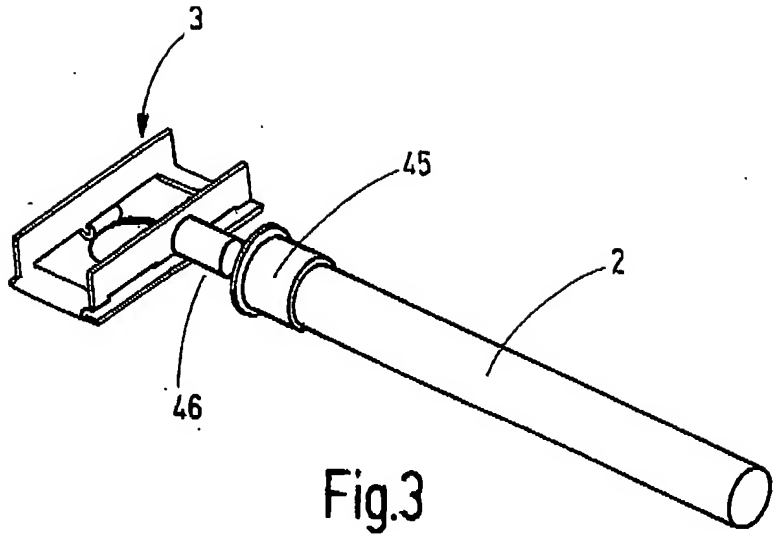

Fig.3

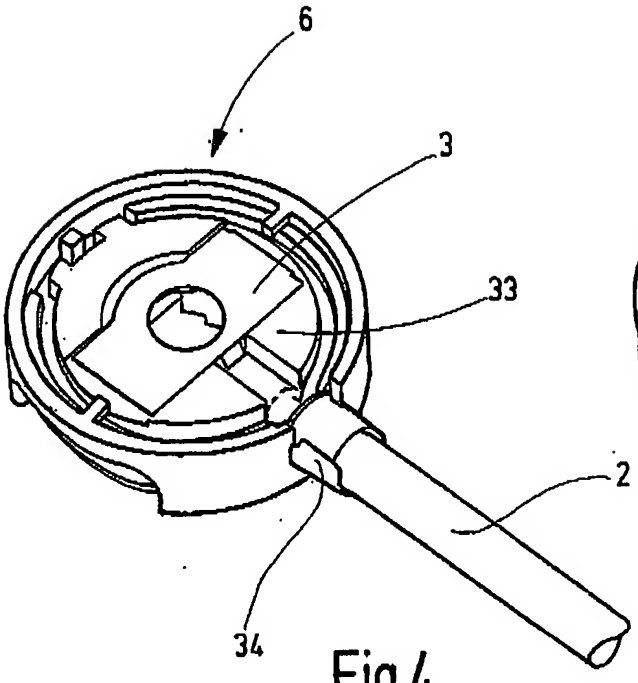

Fig.4

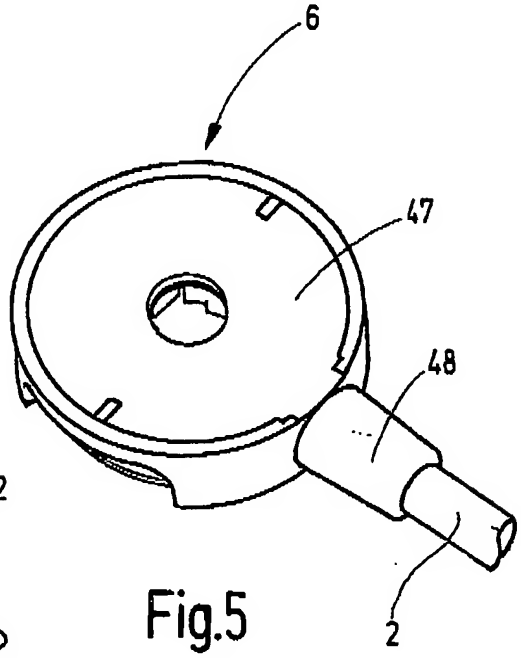

Fig.5

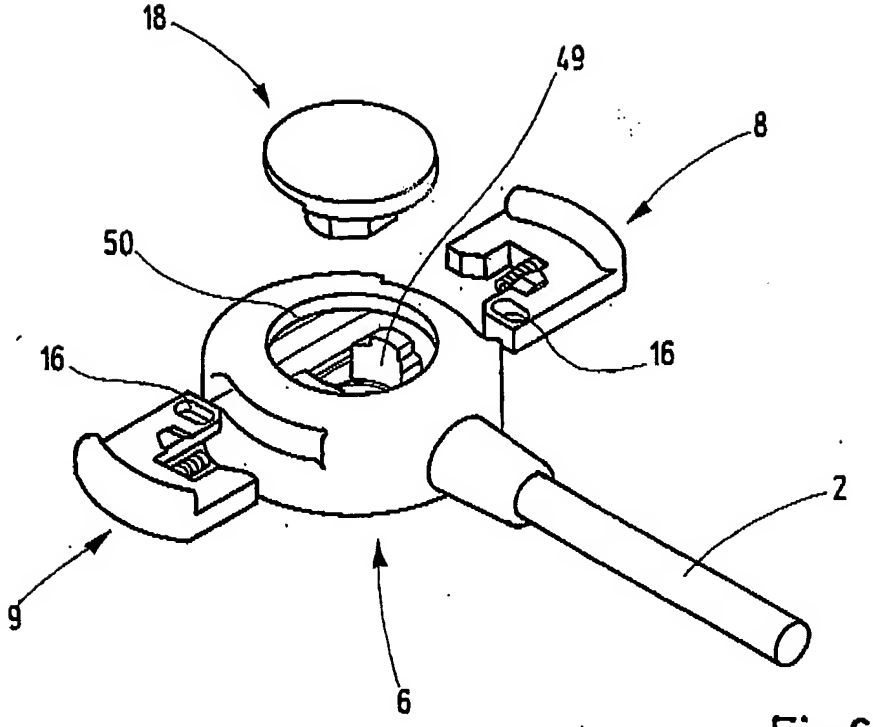

Fig.6

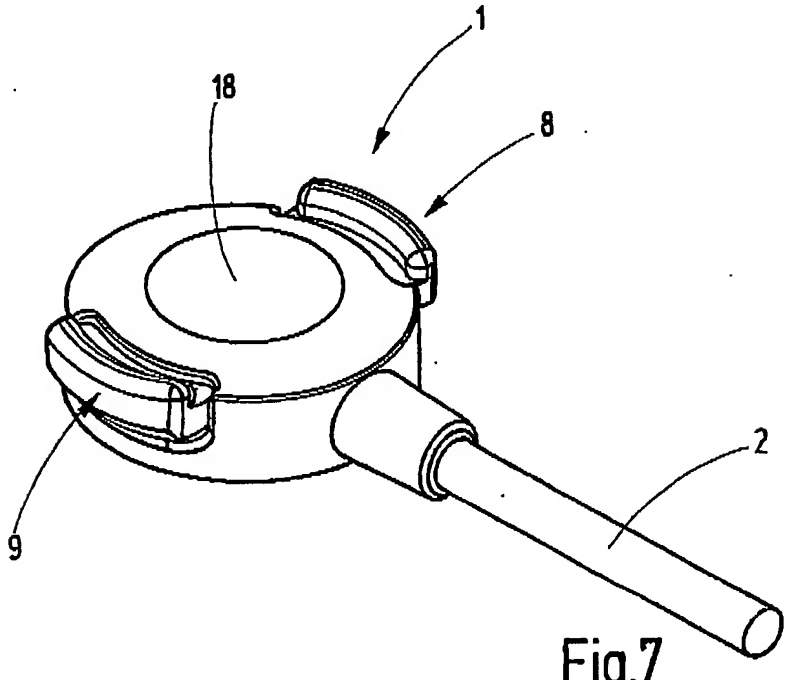

Fig.7